

Air Quality Forecasting During the Southern California Wildfires

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South Coast Air Quality Management District

Technical Track: Air Quality Forecasting

February 24, 2004

Wildfire Smoke Impact Profile

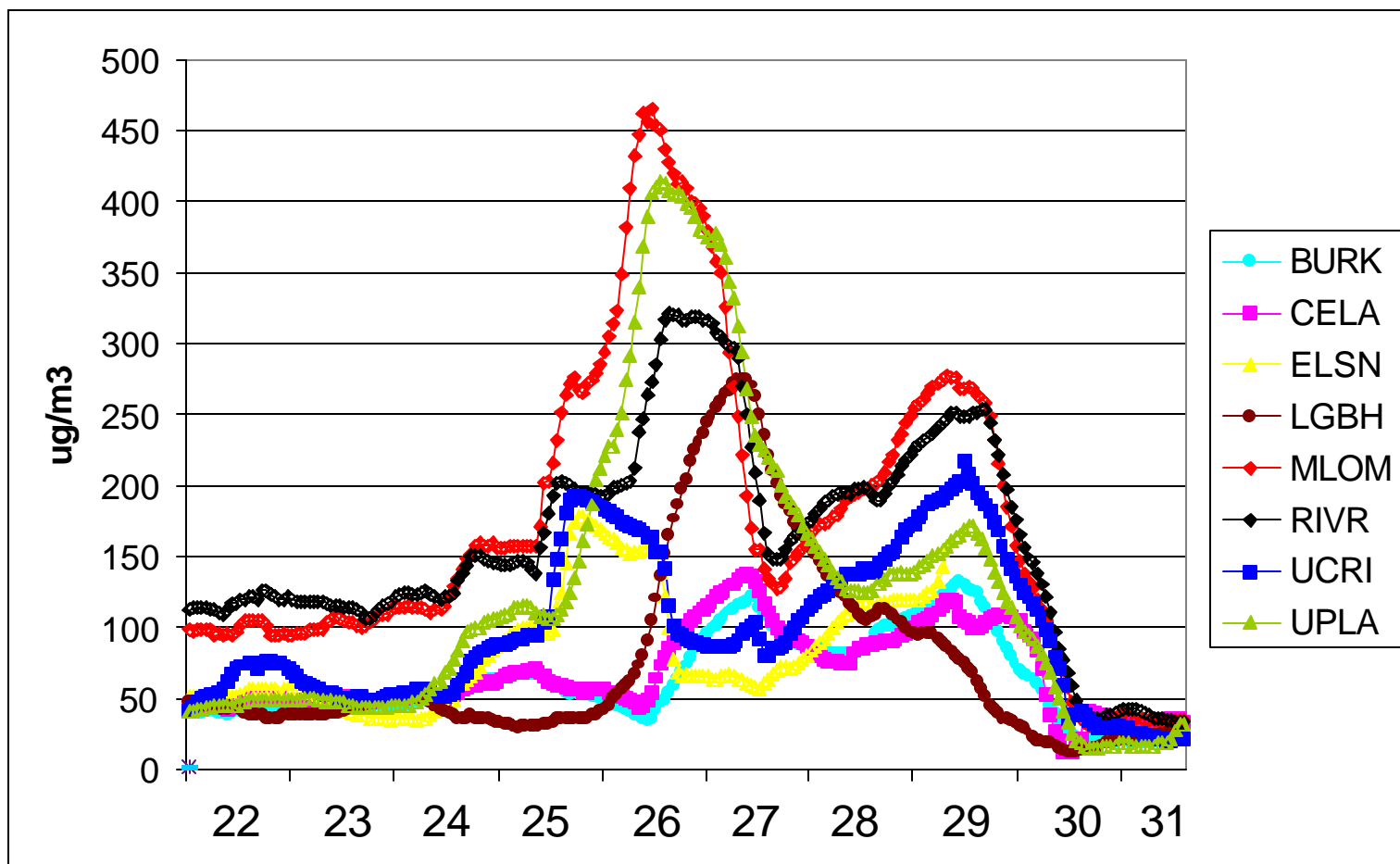
- Wildfires typically break out under offshore or Santa Ana high wind conditions
- Aside from immediate down wind areas plumes are mainly aloft
- Fumigation to the coastal areas occur as the sea breeze returns
- Smoke impacts are minimized as the weather becomes unstable
- The October 2003 blaze began under sea breeze conditions
- Fires burned towards the population centers

Chronology of Events

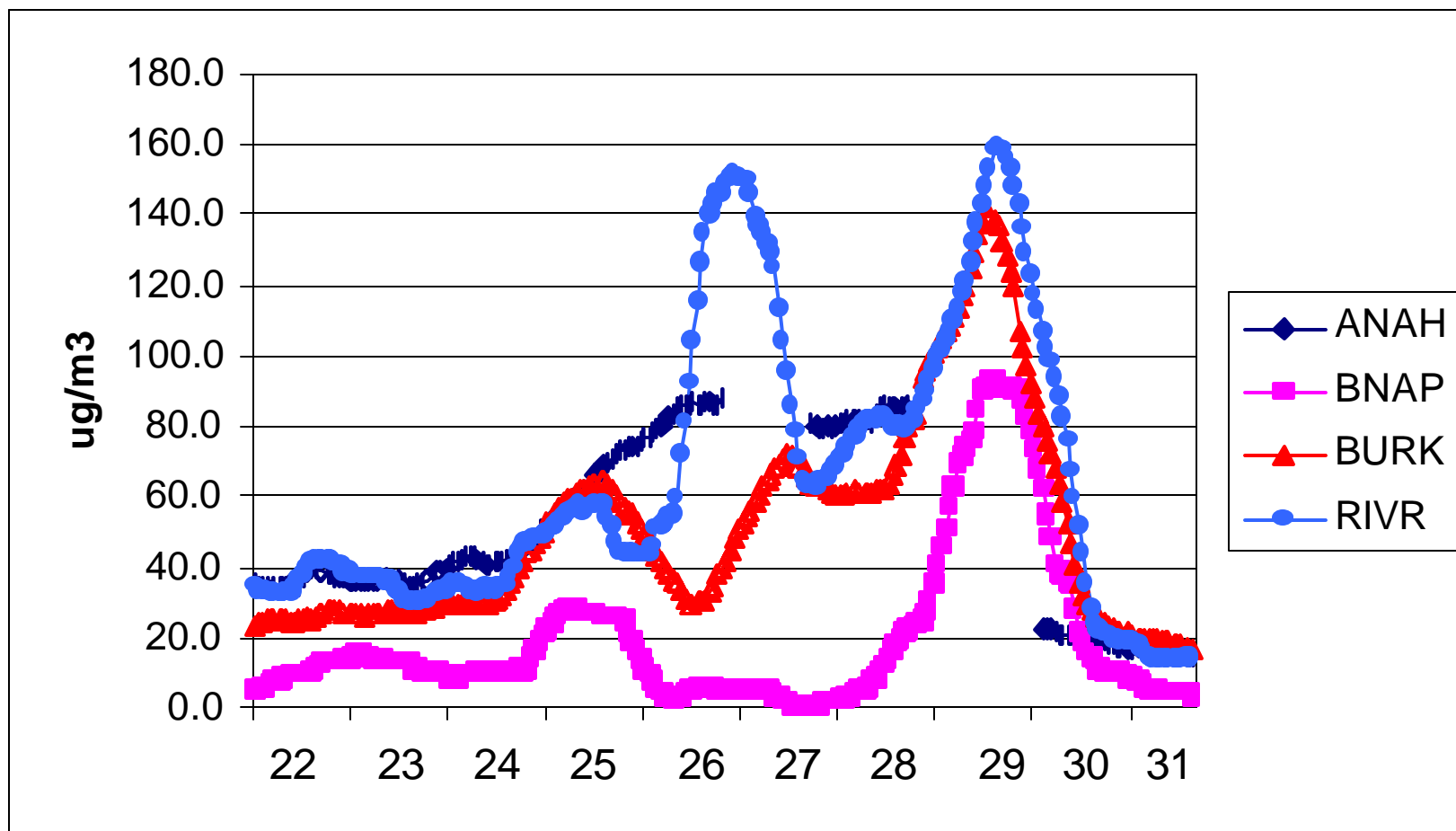
(The Beginning)

- Grand Prix fire started on October 21st
- Firefighters were on the incident and the smoke plume was directed upslope away from populated areas
- Air quality forecast issued for 22nd without knowledge of the fire
- Air quality forecast for 23rd predicts smoke impact as PM10 for the East Basin
- Estimates made for containment evening of the 23rd or early on the 24th
- The fire was larger than estimated and burned through the night

TEOM & BAM 24-Hour Average PM10



BAM 24-Hour Average PM2.5



Operational Background

- Objective PM10 & PM2.5 forecast model designed for urban smog, not wildfires
- PM10 persistence will calibrate forecast to incorporate smoke impact, but not completely
- BAM PM2.5 monitors operational but offline to AIRNOW because of calibration issues
- Early-middle phase: forecasters more comfortable depicting smoke impact as PM10
- Forecast PM10/PM2.5 for 48 source receptor areas (SRA)
- Continuous PM10/PM2.5 reported for only 13 SRAs

Meteorological Profile: Early Phase of the Fire

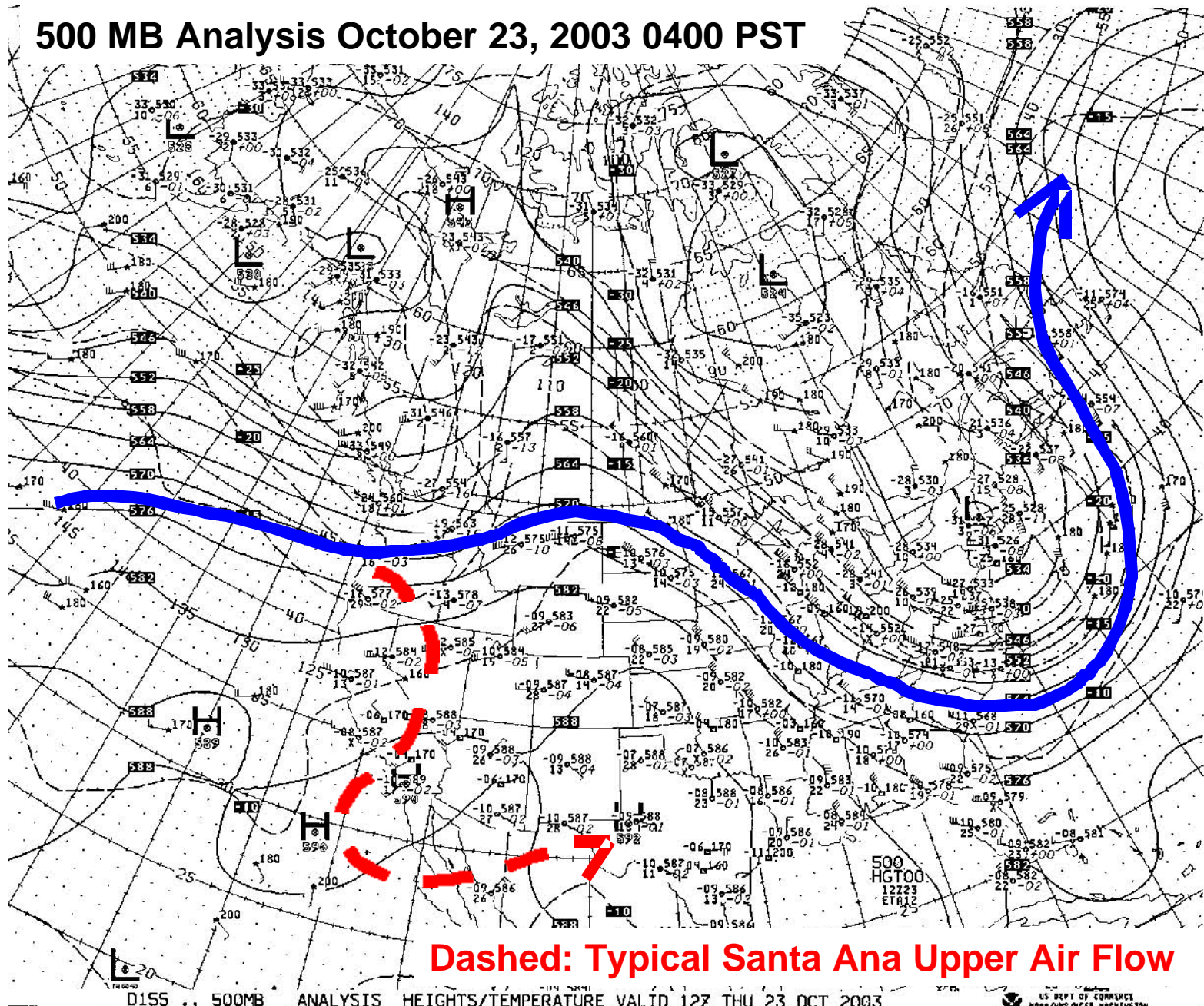
October 21-23

- Zonal flow aloft at 500 mb with a minor trough in the Pacific Northwest
- Weak onshore sea breeze flow at the surface

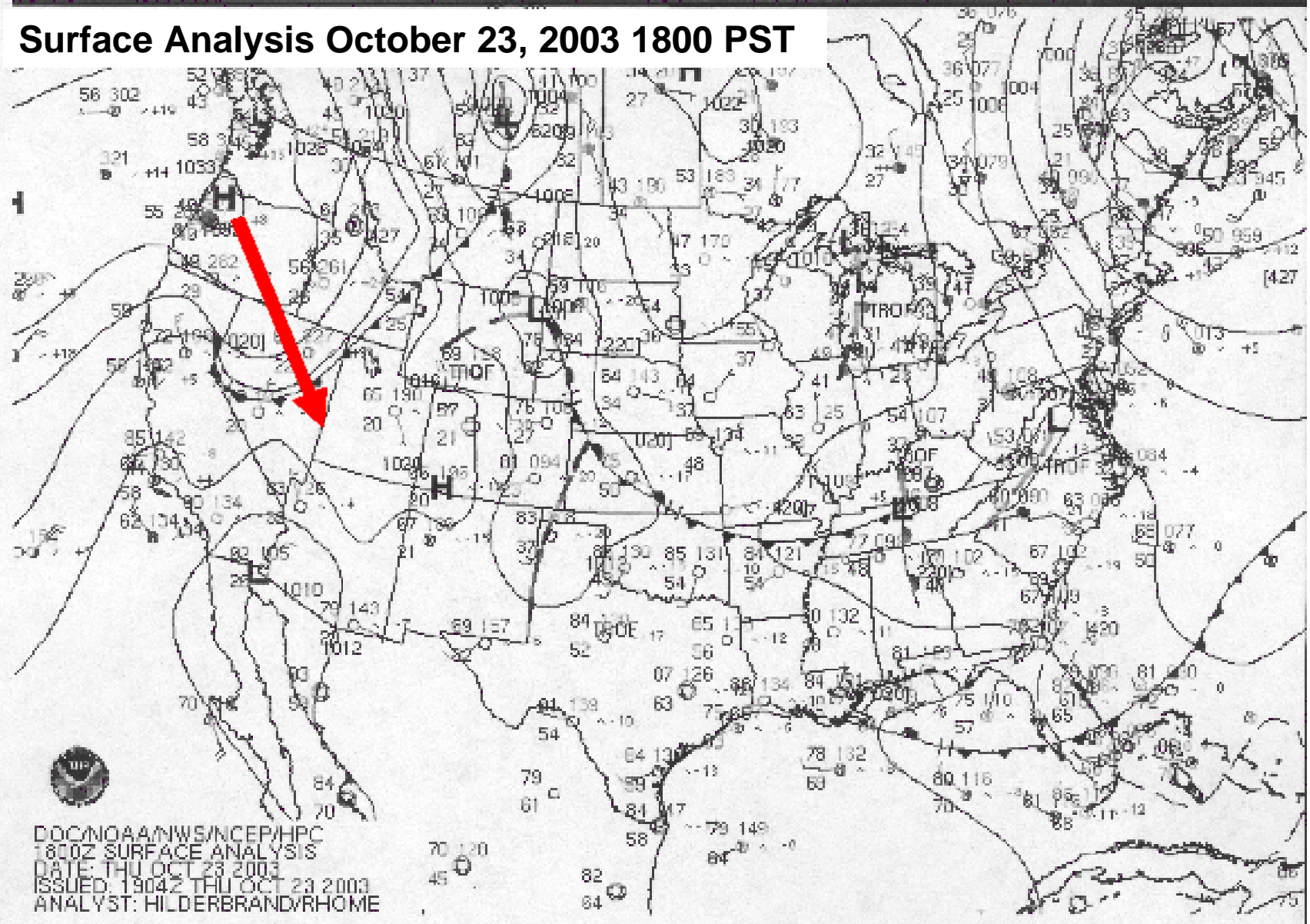
October 24

- Building west coast ridge aloft
- Stagnant surface winds on the 24th
- Prediction of moderate Santa Ana developing Oct. 25th

500 MB Analysis October 23, 2003 0400 PST



Surface Analysis October 23, 2003 1800 PST



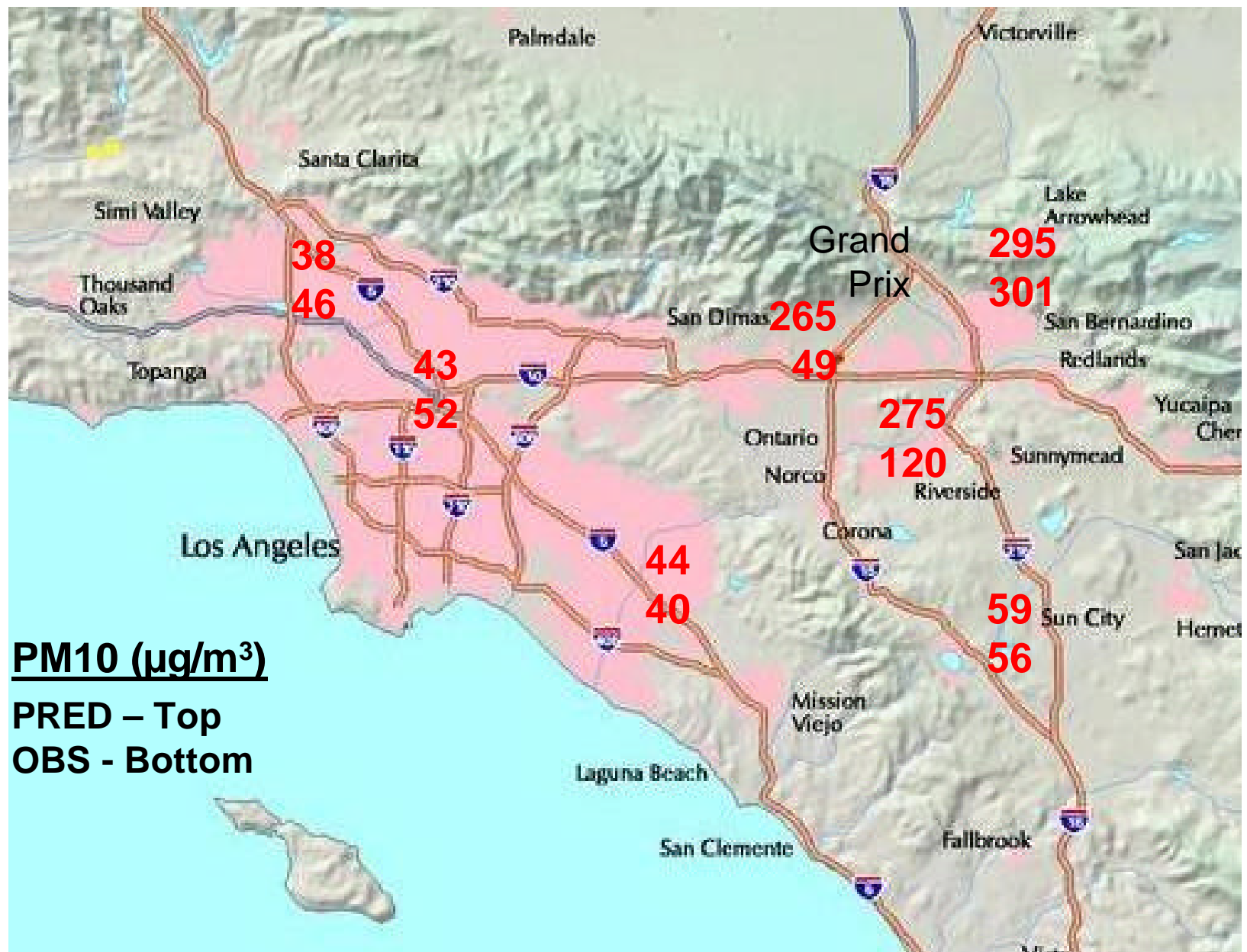
Grand Prix Fire October 23, 2003



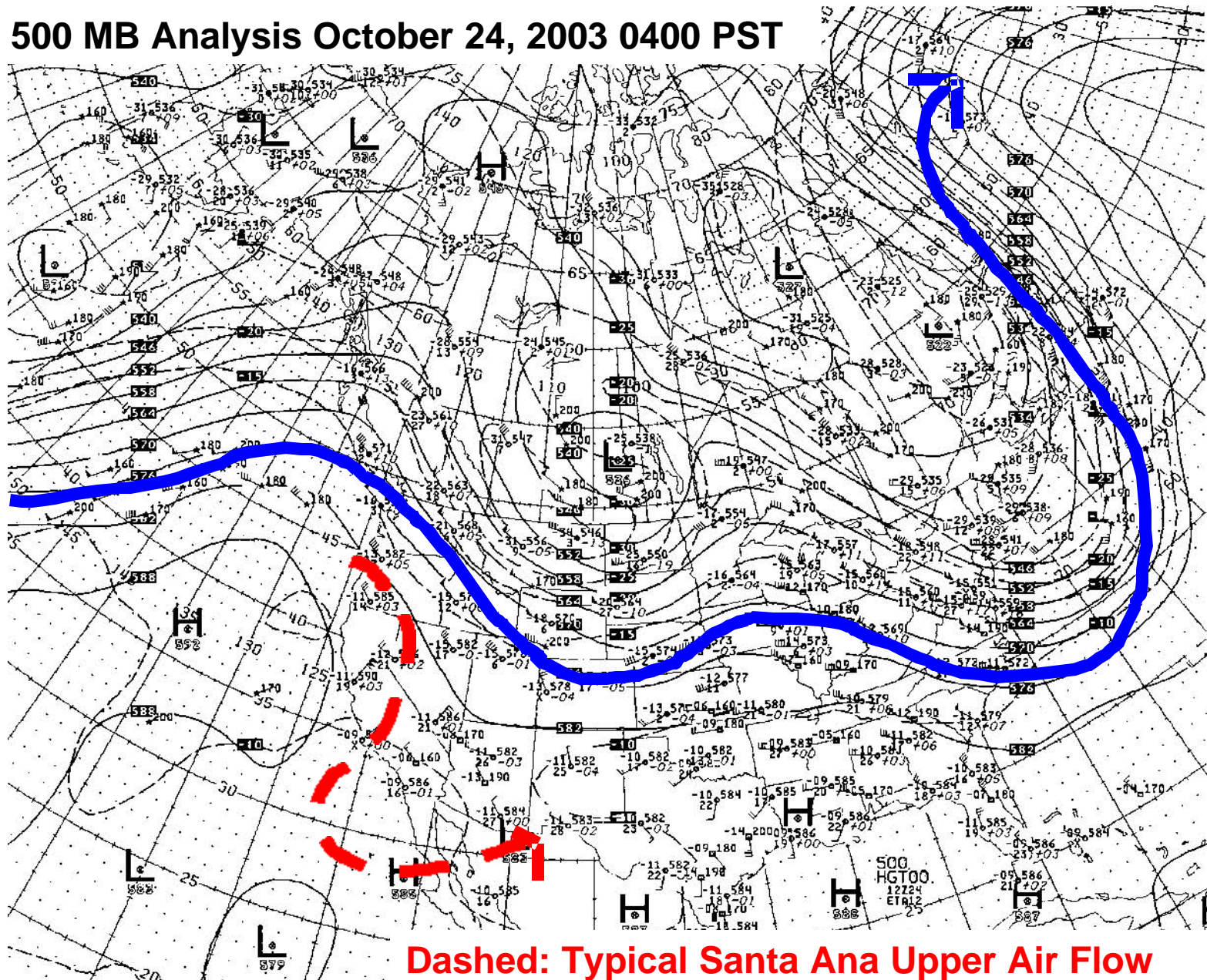
Primary Smoke Impact Area October 21-23



PM10 Predicted and Observed: Oct 23rd



500 MB Analysis October 24, 2003 0400 PST



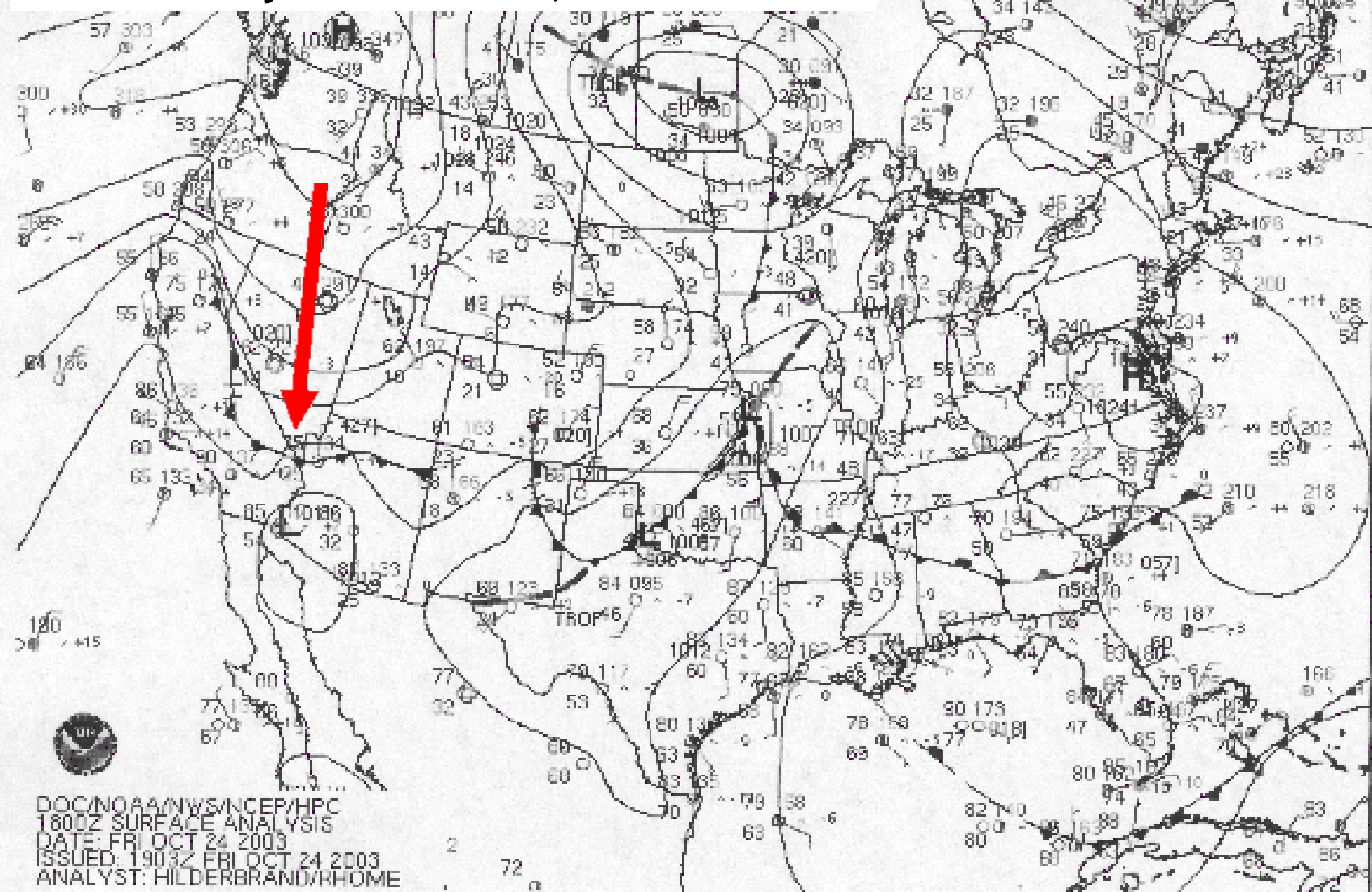
Dashed: Typical Santa Ana Upper Air Flow

D155 .. 500MB ANALYSIS HEIGHTS/TEMPERATURE VALID 12Z FRI 24 OCT 2003

US DEPT OF COMMERCE
NWS/NWS/NEP WASHINGTON

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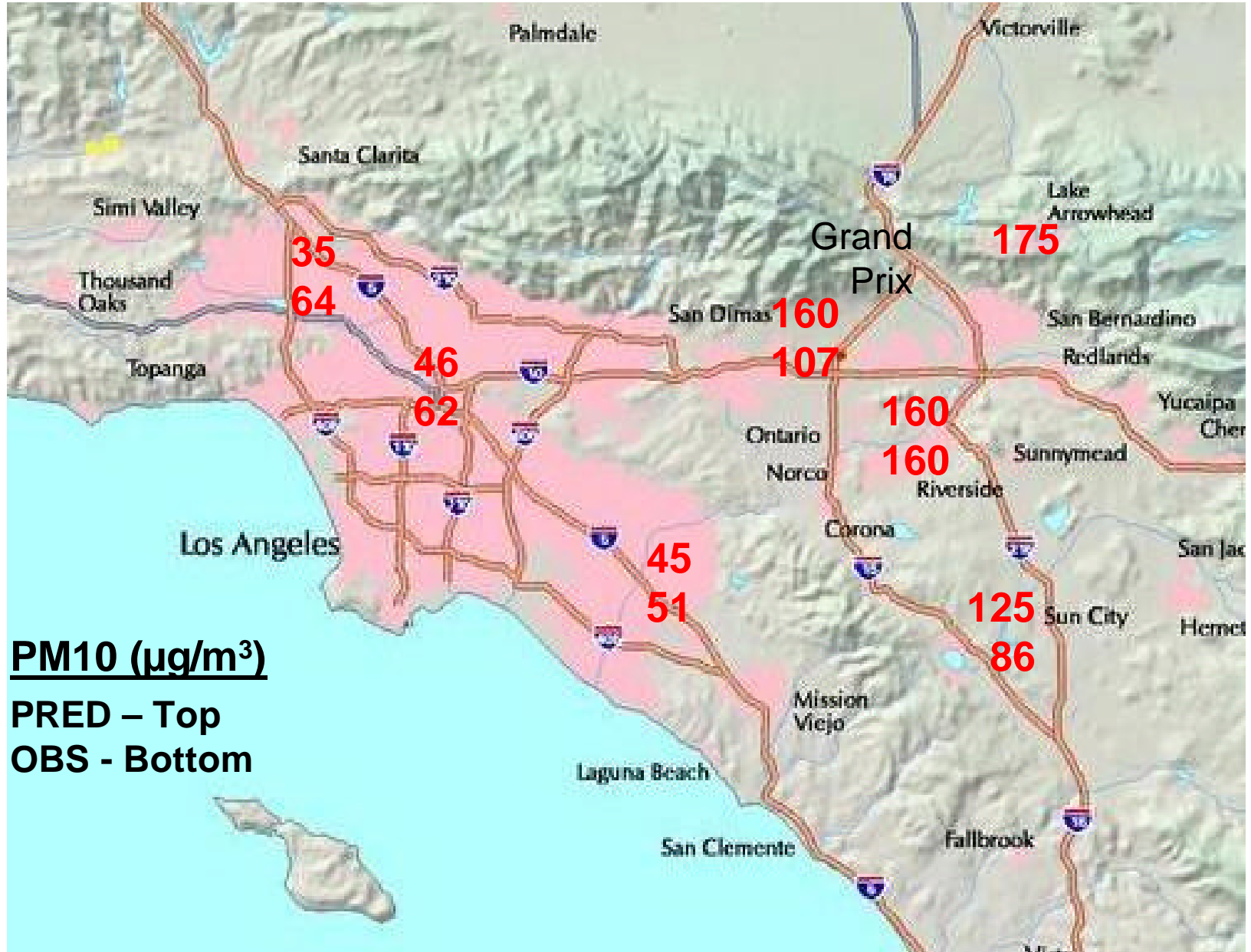
Surface Analysis October 24, 2003 1800 PST



Primary Smoke Impact Area October 24th



PM10 Predicted and Observed: Oct 24th



Updating the Forecast and Predicting for 25th

- Stagnant winds fumigate the smoke plume over wide area of Basin
- Update the forecast to include areas west of primary impact zone
- Unpopular cancellation of many outdoor activities
- Uncertain prediction for 25th
 - > impending Santa Ana
 - > possible containment
- Hedged on the side caution

SPECIAL SMOKE ADVISORY: Valid Friday, October 24, 2003

Due to the wildfires in southern California, localized areas of smoke have occurred in the Basin. As a result, concentrations of fine particulates are expected to reach the unhealthy level in the smoke impacted areas.

All individuals are urged to exercise caution and avoid unnecessary outdoor activities in the smoke impacted areas.

Today, October 24, 2003, a PM2.5/PM10 Smoke Advisory is in effect in the following areas:

Area #	Monitoring Area	Description	Pollutant	AQI	Time
9	East San Gabriel Valley	Unhealthy-Sensitive	PM2.5/PM10	125	All Day
10	Pomona/Walnut Valley	Unhealthy-Sensitive	PM2.5/PM10	125	All Day
11	South San Gabriel Valley	Unhealthy-Sensitive	PM2.5/PM10	125	All Day
22	Norco/Corona	Unhealthy	PM2.5/PM10	155	All Day
23	Metropolitan Riverside	Unhealthy	PM2.5/PM10	155	All Day
24	Perris Valley	Unhealthy	PM2.5/PM10	155	All Day
32	Northwest San Bernardino Vly	Unhealthy	PM2.5/PM10	165	All Day
33	Southwest San Bernardino Vly	Unhealthy	PM2.5/PM10	165	All Day
34	Central San Bernardino Valley	Unhealthy	PM2.5/PM10	165	All Day
35	East San Bernardino Valley	Unhealthy	PM2.5/PM10	155	All Day
36	West San Bernardino Mtns	Unhealthy	PM2.5/PM10	170	All Day
37	Central San Bernardino Mtns	Unhealthy	PM2.5/PM10	170	All Day

Tomorrow's Forecast: Valid Saturday, October 25, 2003

Tomorrow, October 25, 2003, air quality is predicted to be GOOD to MODERATE in most areas, but air pollution levels will exceed 100 on the Air Quality Index (AQI) in the following areas:

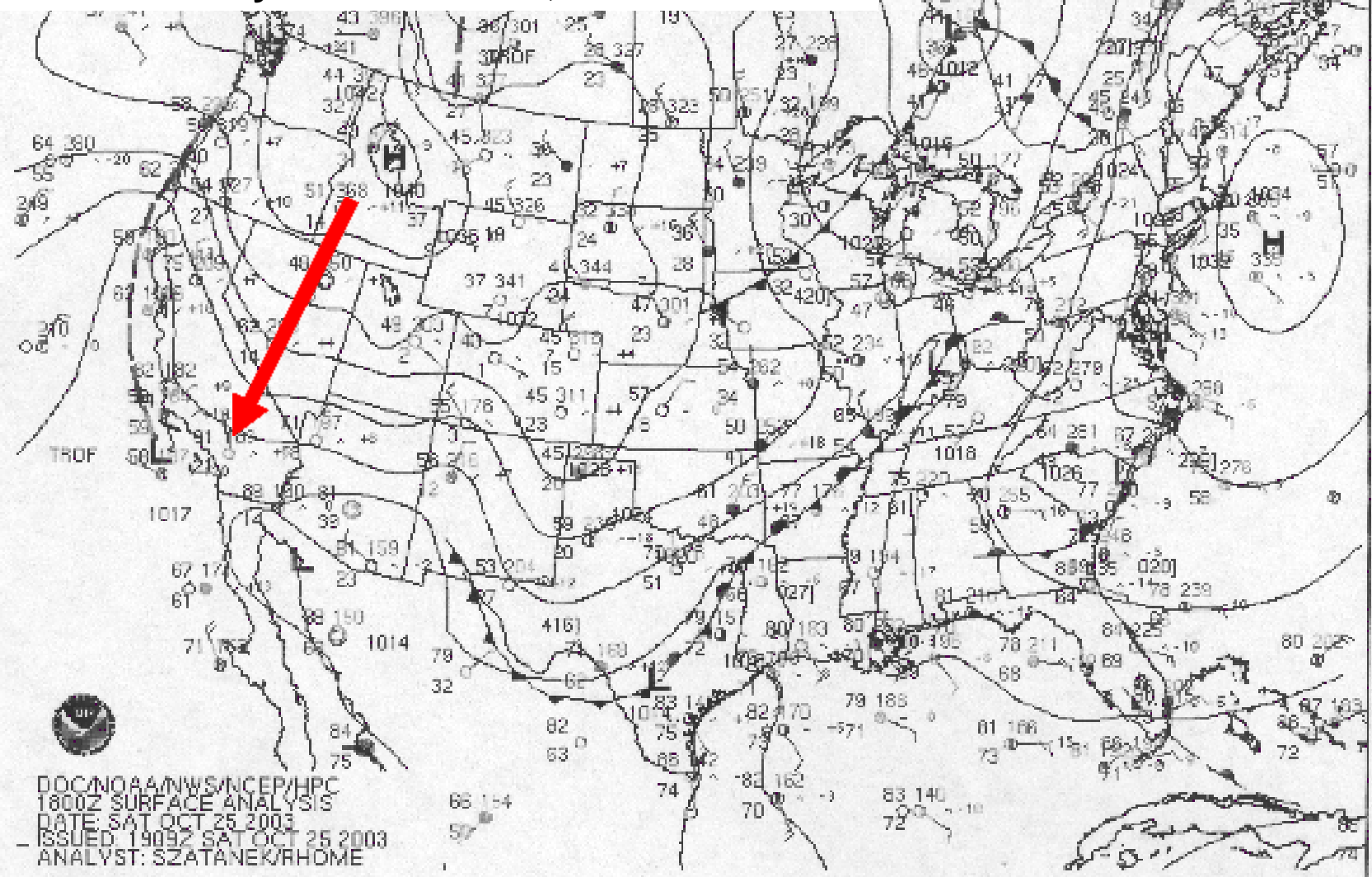
Area #	Monitoring Area	Description	Pollutant	AQI	Time
9	East San Gabriel Valley	Unhealthy-Sensitive	PM2.5/PM10	123	All Day
10	Pomona/Walnut Valley	Unhealthy-Sensitive	PM2.5/PM10	123	All Day
22	Corona/Norco	Unhealthy	PM2.5/PM10	155	All Day
23	Metropolitan Riverside	Unhealthy	PM2.5/PM10	155	All Day
24	Perris Valley	Unhealthy	PM2.5/PM10	155	All Day
32	Northwest San Bernardino Vly	Unhealthy	PM2.5/PM10	163	All Day
33	Southwest San Bernardino Vly	Unhealthy	PM2.5/PM10	155	All Day
34	Central San Bernardino Valley	Unhealthy	PM2.5/PM10	163	All Day
36	West San Bernardino Mtns	Unhealthy	PM2.5/PM10	173	All Day
37	Central San Bernardino Mtns	Unhealthy	PM2.5/PM10	173	All Day

Meteorological Profile: The Santa Ana Begins

October 25

- Strong west coast ridge aloft at 500 mb placing the Basin subsidence zone
- Main NW-SE jet 500 mile east of the Basin
- Strong N-NE offshore Santa Ana winds (40+ mph) at the surface but with little upper air support
- NE winds in the east Basin push Grand Prix fire towards LA
- Weak sea breeze along the coast
- Old fire is set by arsonist and Piru fire Ignites Simi fire

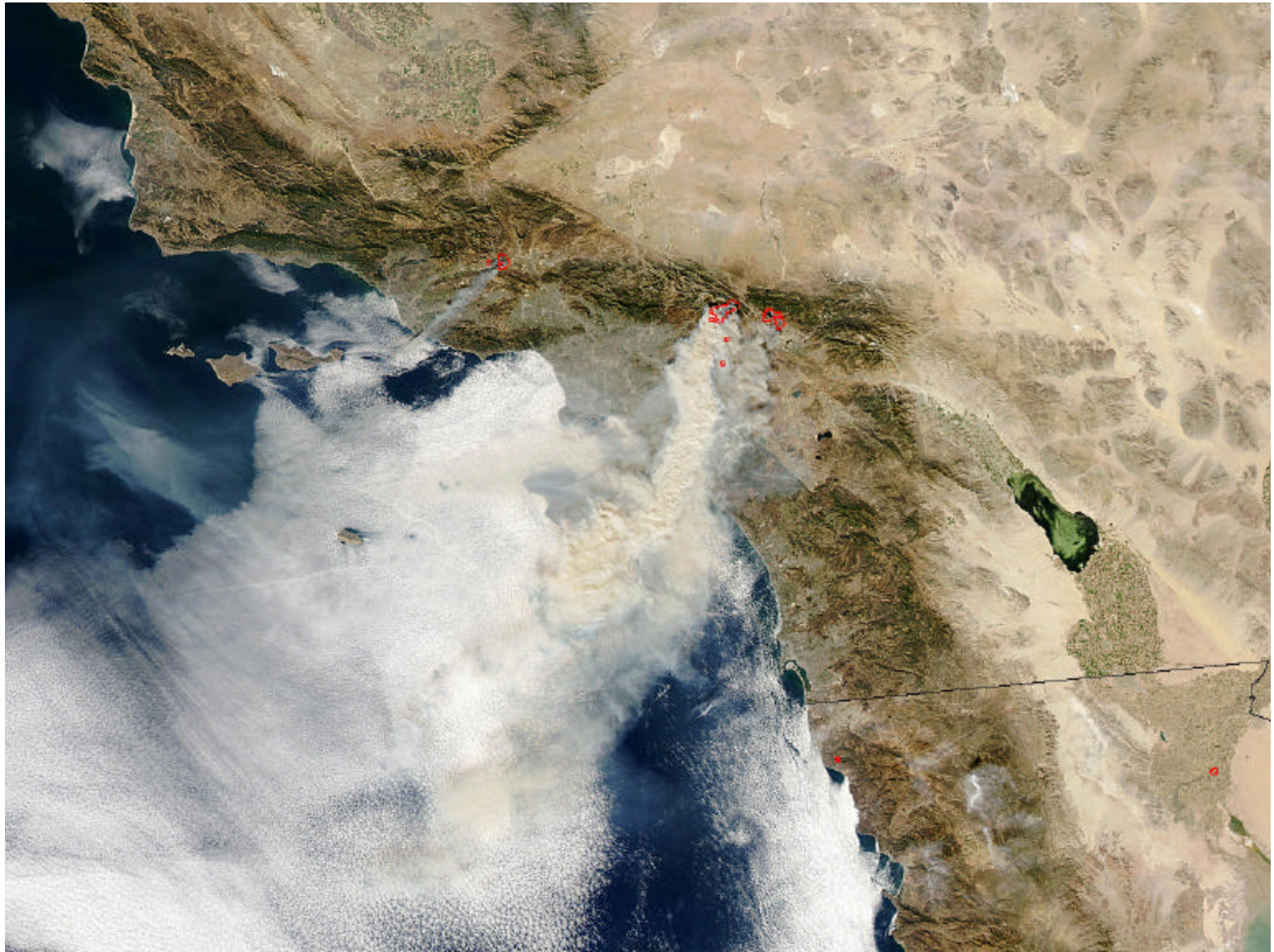
Surface Analysis October 25, 2003 1800 PST



October 25th



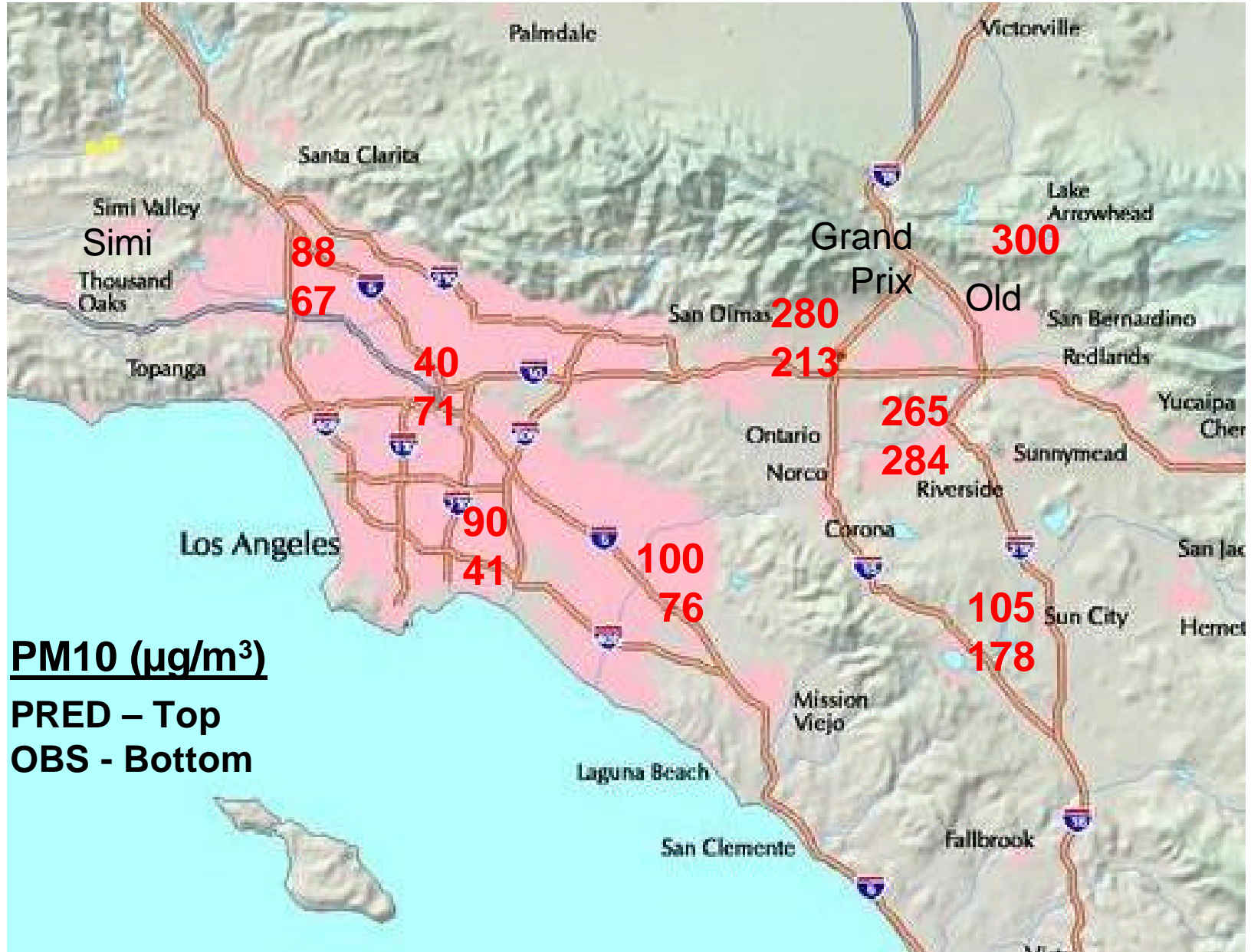
October 25th



Primary Smoke Impact Area October 25



PM10 Predicted and Observed: Oct 25th



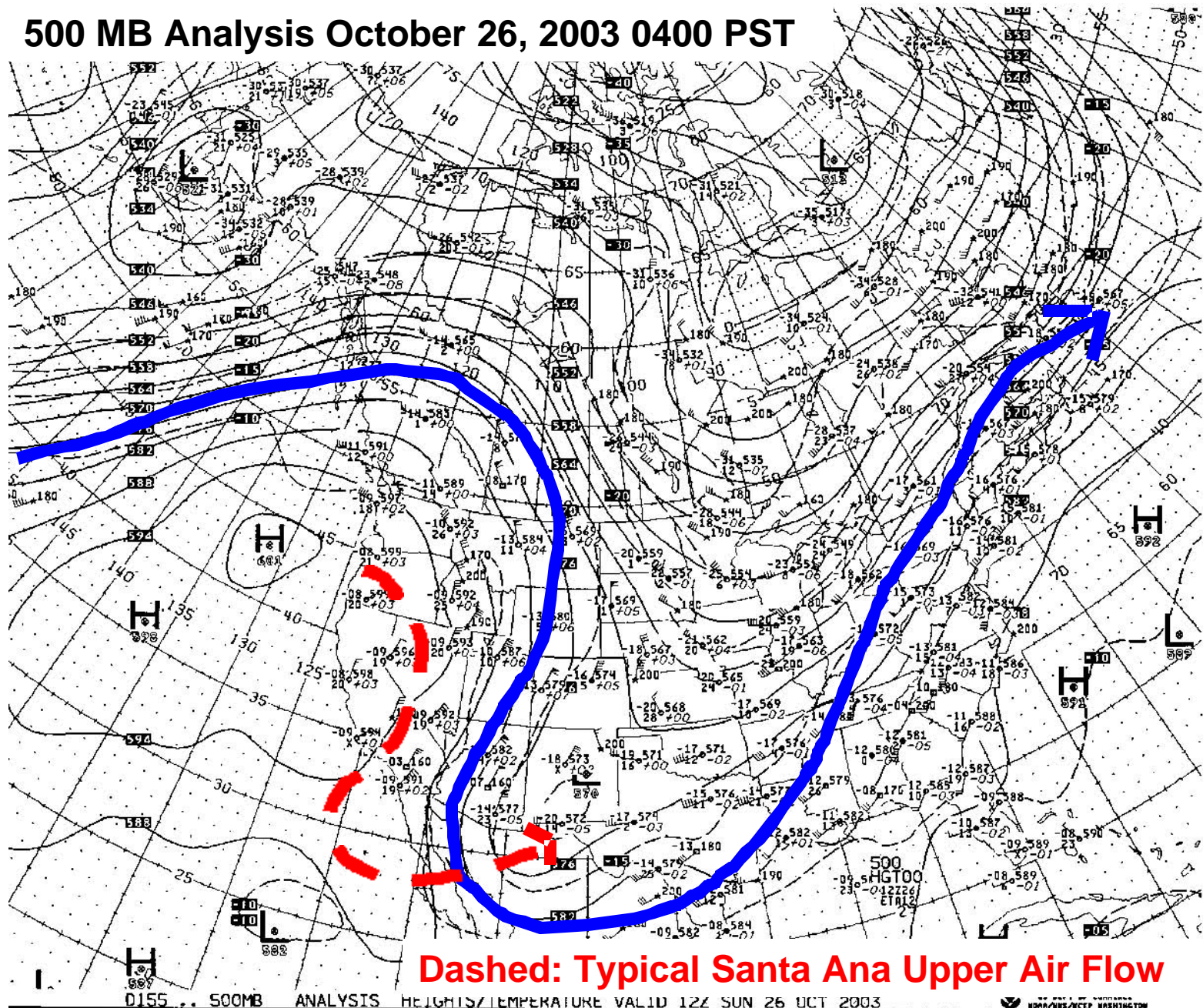
Meteorological Profile:

The Santa Ana Reaches Maximum Strength

October 26

- 500 mb High off west coast analyzed at 6000+ meters
- N-S jet aloft parallels the route of a reinforced Santa Ana but is shifted east of Colorado River
- NE Santa Ana winds (40+ mph) continue to feed the fires but with little upper air support
- Weak sea breeze continues along the coast aiding to fumigation of smoke

500 MB Analysis October 26, 2003 0400 PST



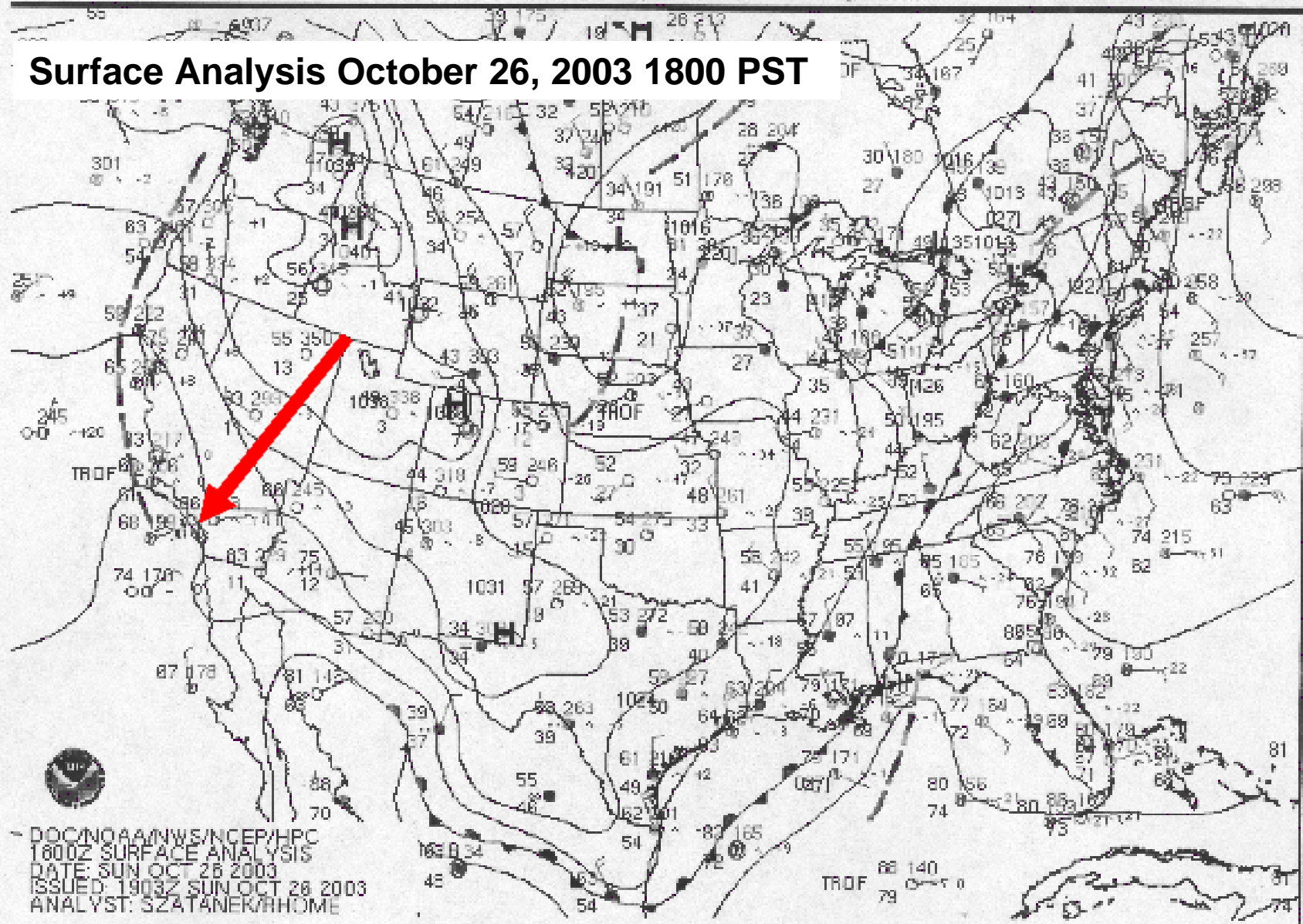
Dashed: Typical Santa Ana Upper Air Flow

0155 500MB ANALYSIS HEIGHT/TEMPERATURE VALID 12Z SUN 26 OCT 2003

50460854.PCX 10/26/2003 14:14:00 QHTA11

NOAA/NCEP/NCAR

Surface Analysis October 26, 2003 1800 PST



- DOC/NOAA/NWS/NCEP/HPC
1800Z SURFACE ANALYSIS
DATE: SUN OCT 26 2003
ISSUED: 1903Z SUN OCT 26 2003
ANALYST: SZATANEK/RHOME

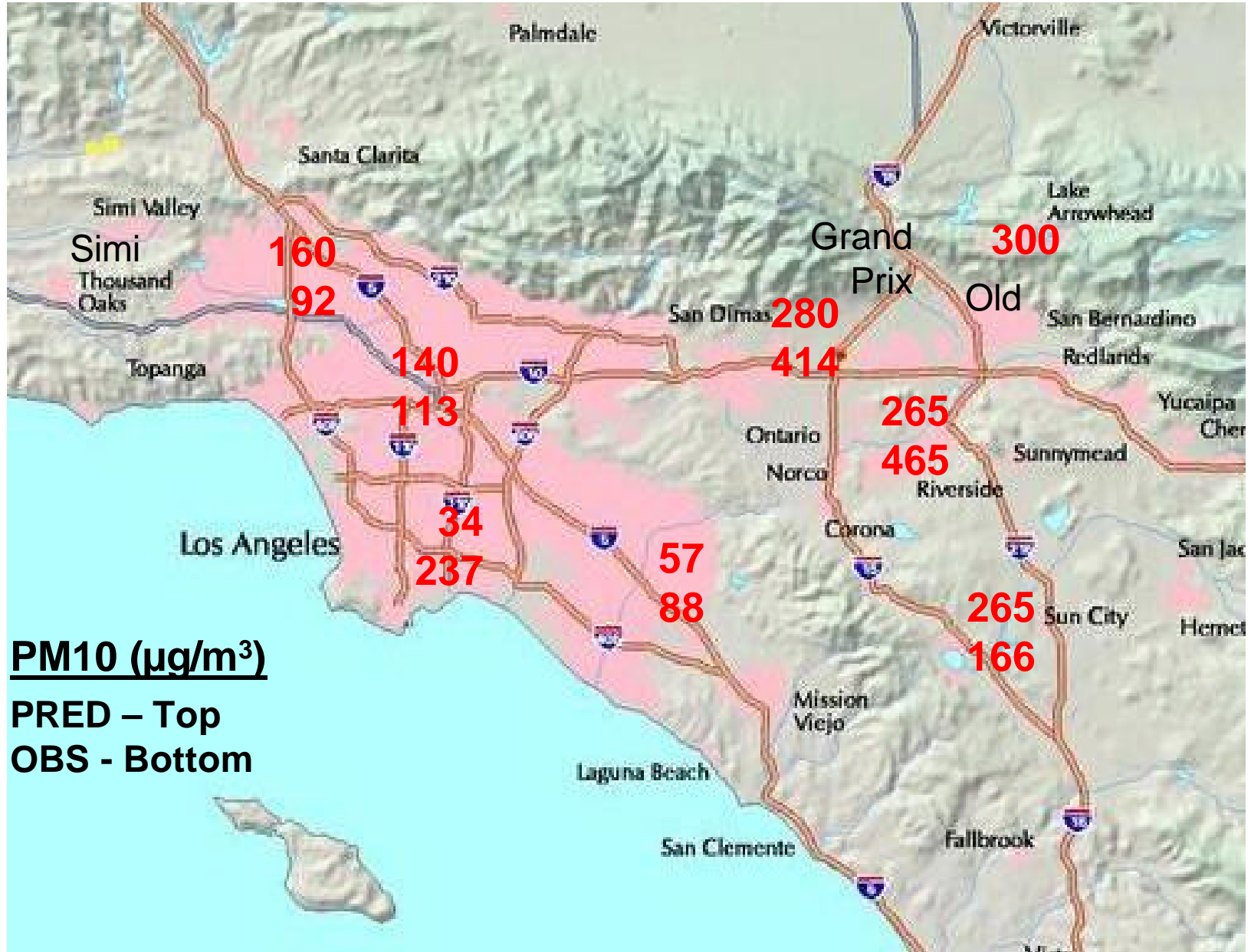


- Smoke transport towards the coast from Old and Grand Prix fires
- View looking west-northwest

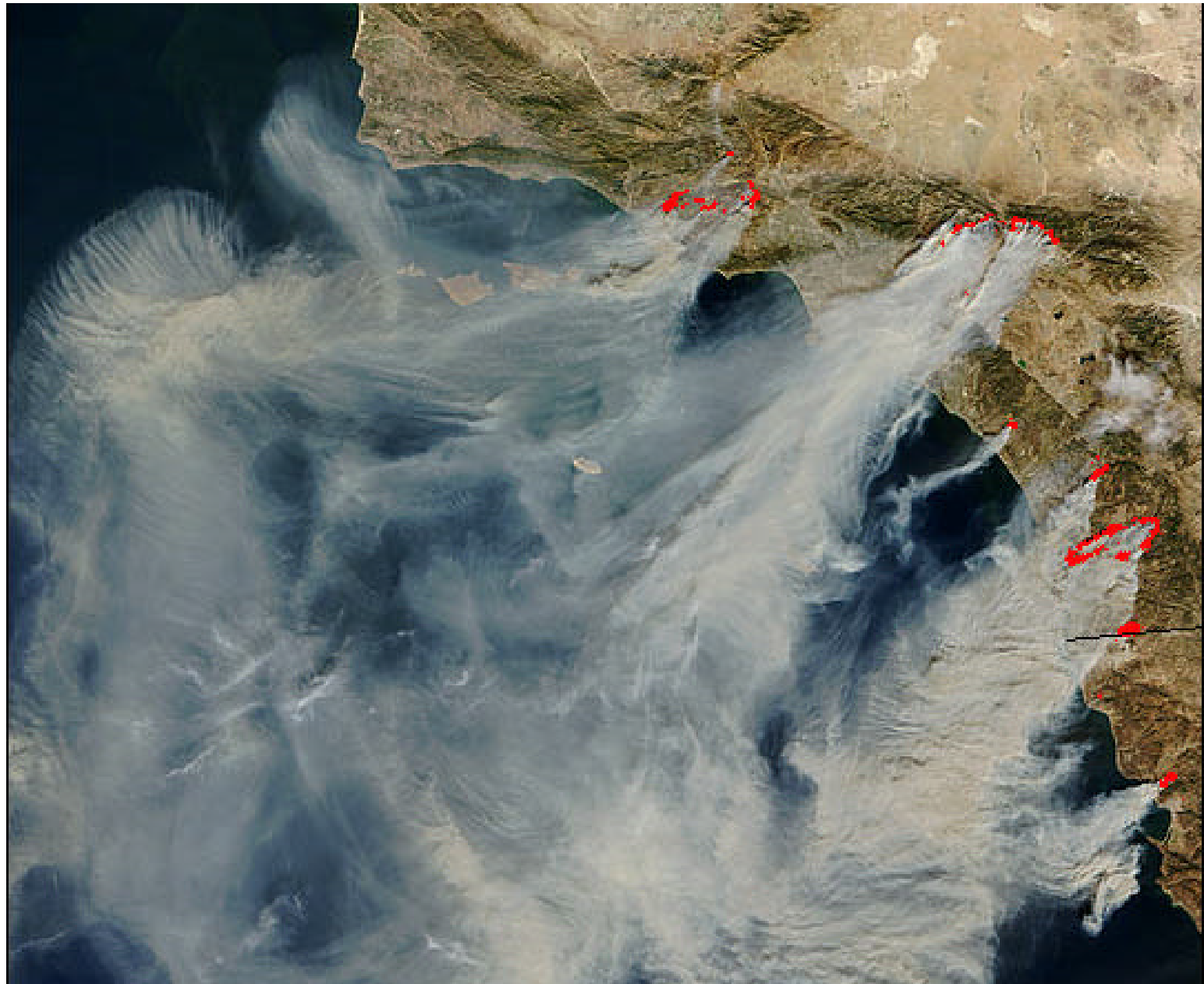
Primary Smoke Impact Area October 26



PM10 Predicted and Observed: Oct 26th



October 26-27, 2003



Meteorological Profile: The Santa Ana Retreats

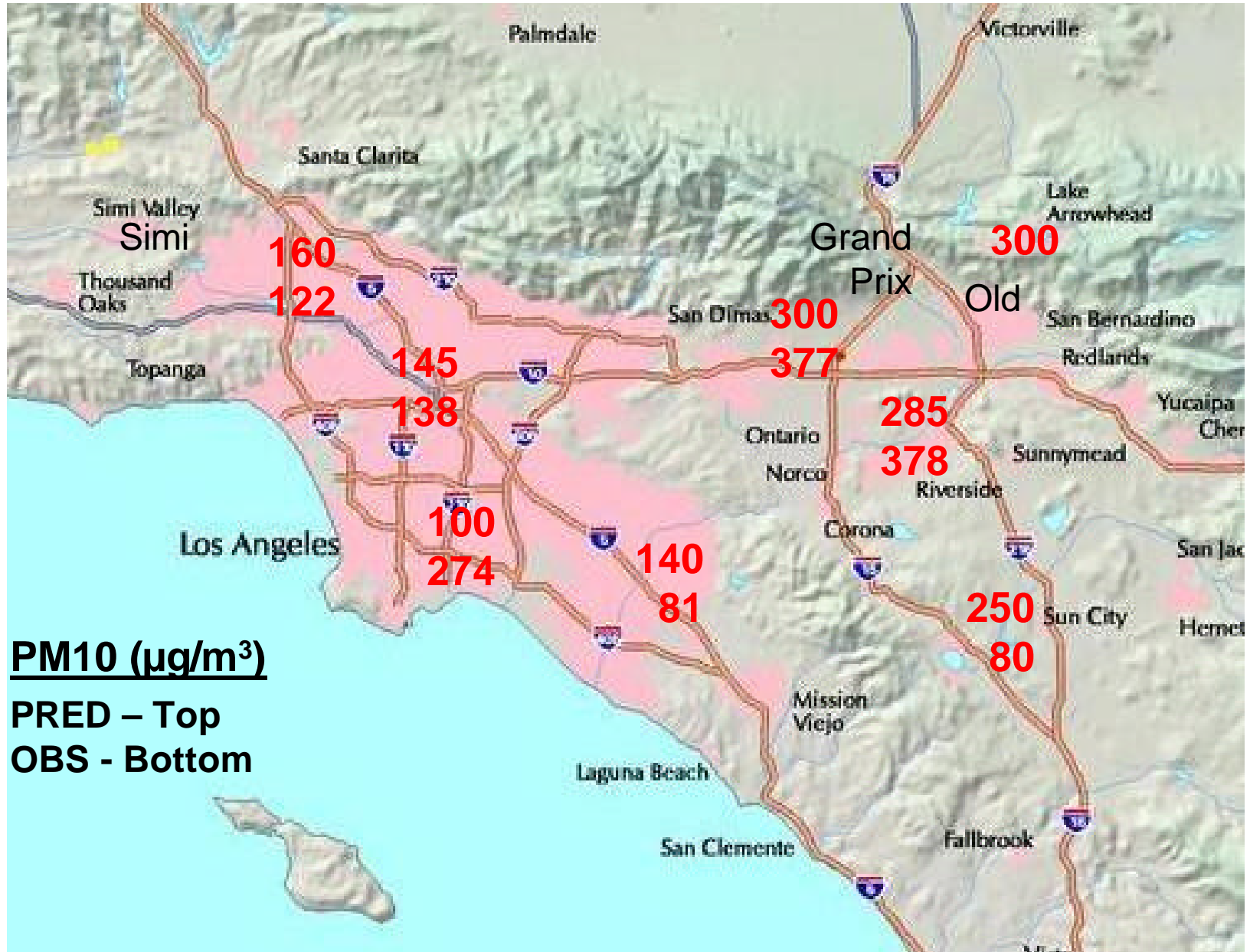
October 27 & 28

- 500 mb High remains off west coast but begins to weaken
- Jet aloft shifted further east
- Great Basin surface High begins to weaken but continues to produce periods of gusty NE Santa Ana winds (40+ mph) primarily in mountains and passes
- Sea breeze begins to dig into Basin continuing to assist fumigation of smoke
- Concerns of San Diego plume to be transported north by developing coast eddy

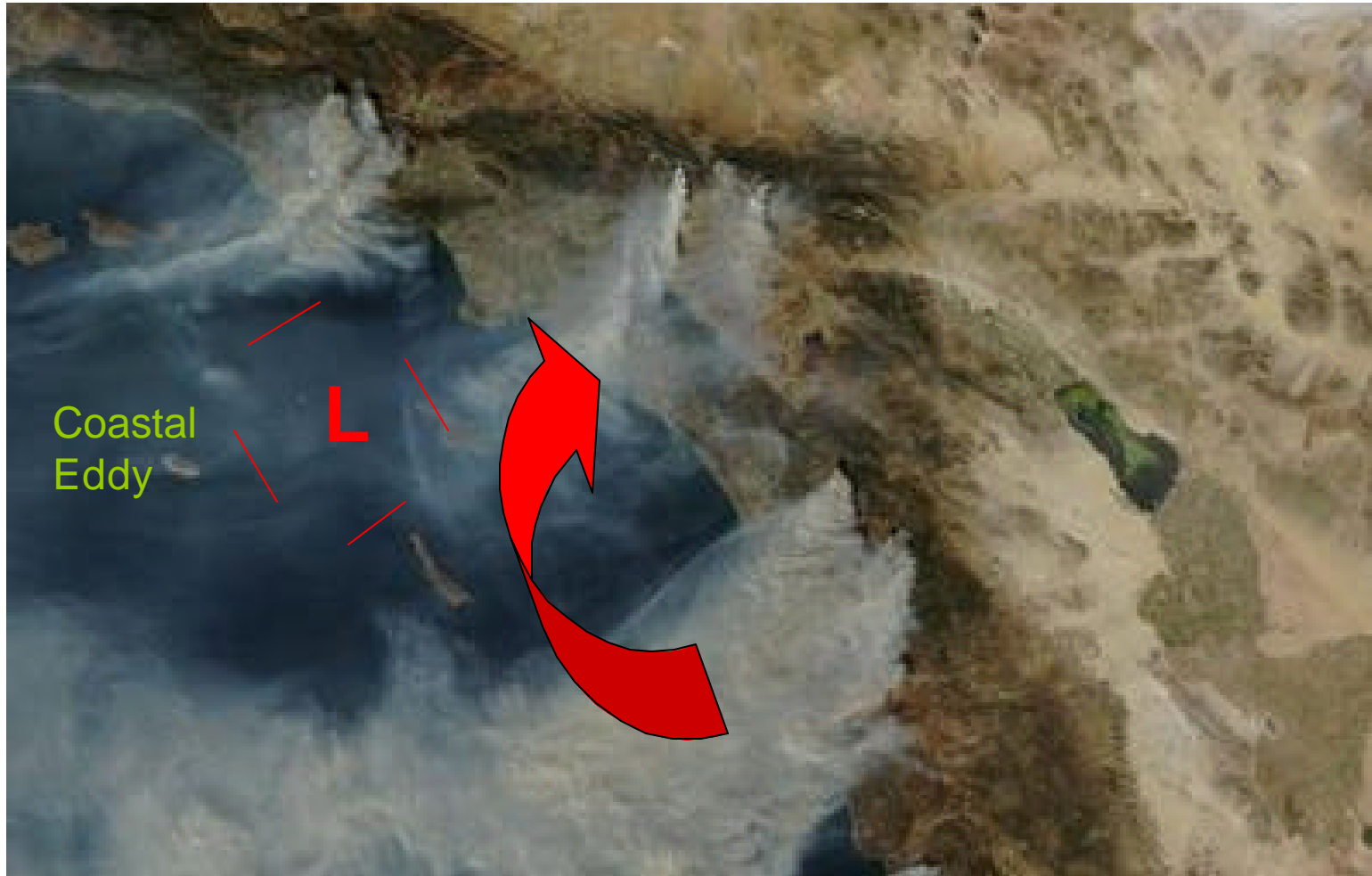
Primary Smoke Impact Area October 27- 28



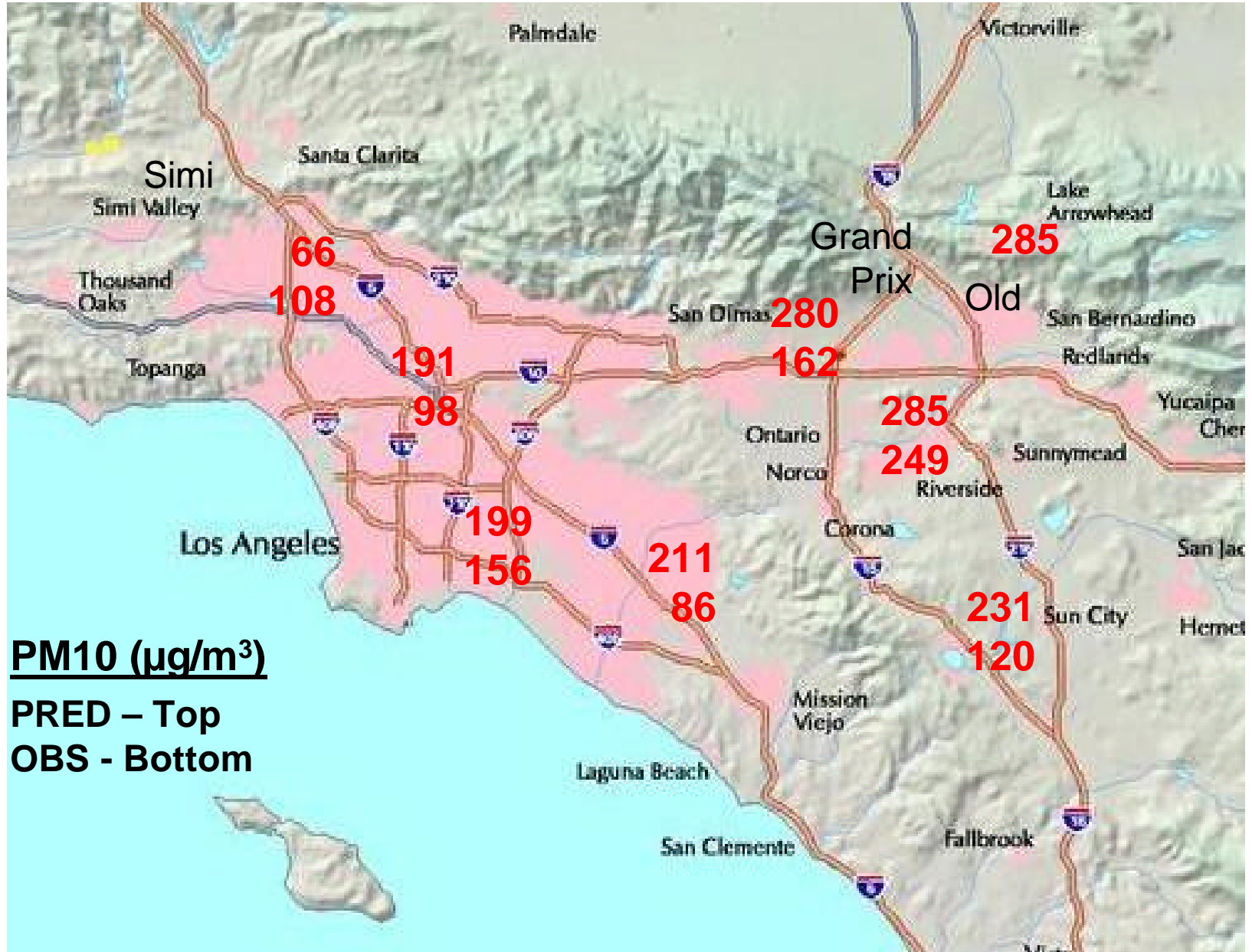
PM10 Predicted and Observed: Oct 27th



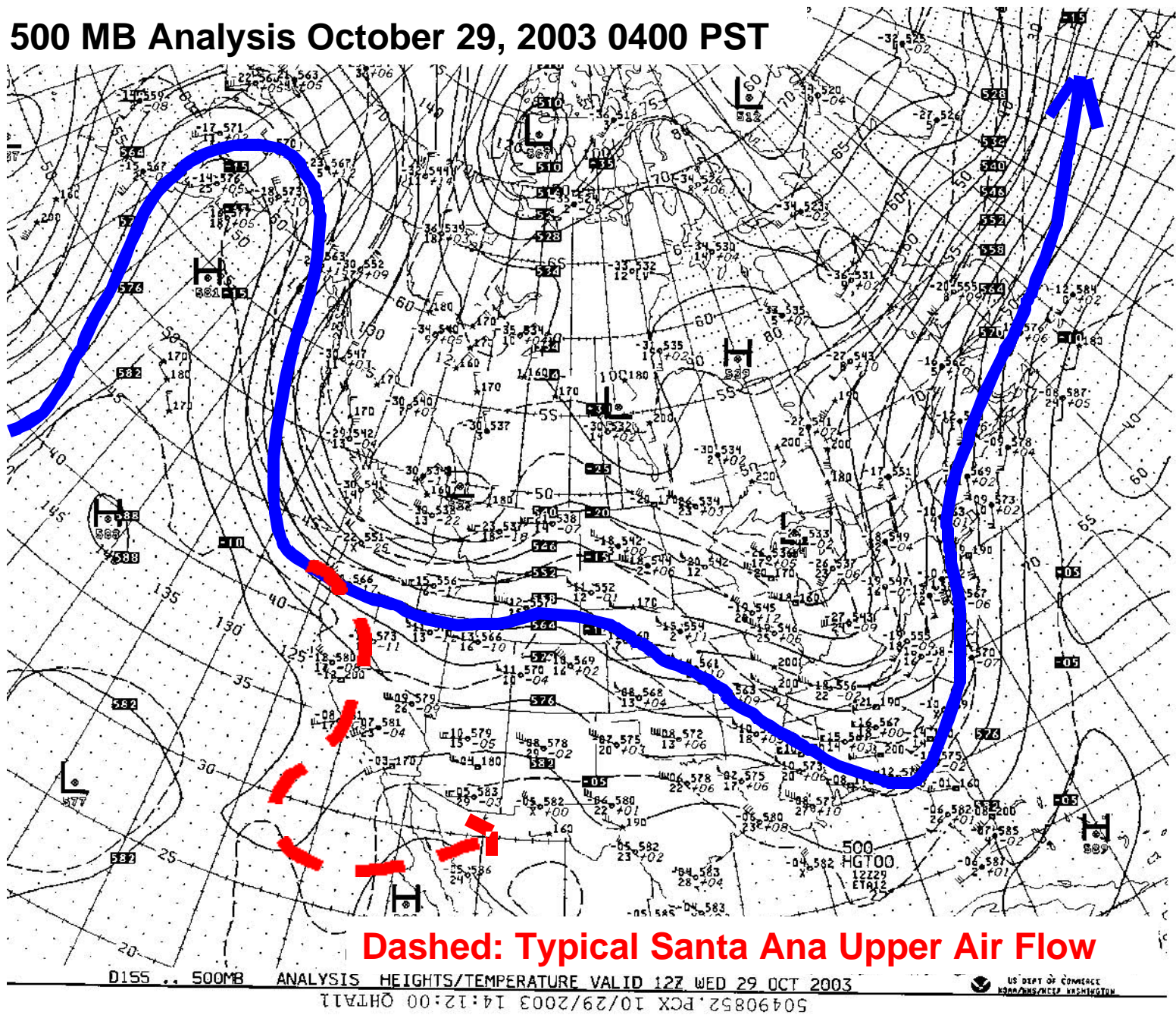
Potential Advection of Smoke Plume Under Coastal Eddy Circulation



PM10 Predicted and Observed: Oct 28th



500 MB Analysis October 29, 2003 0400 PST



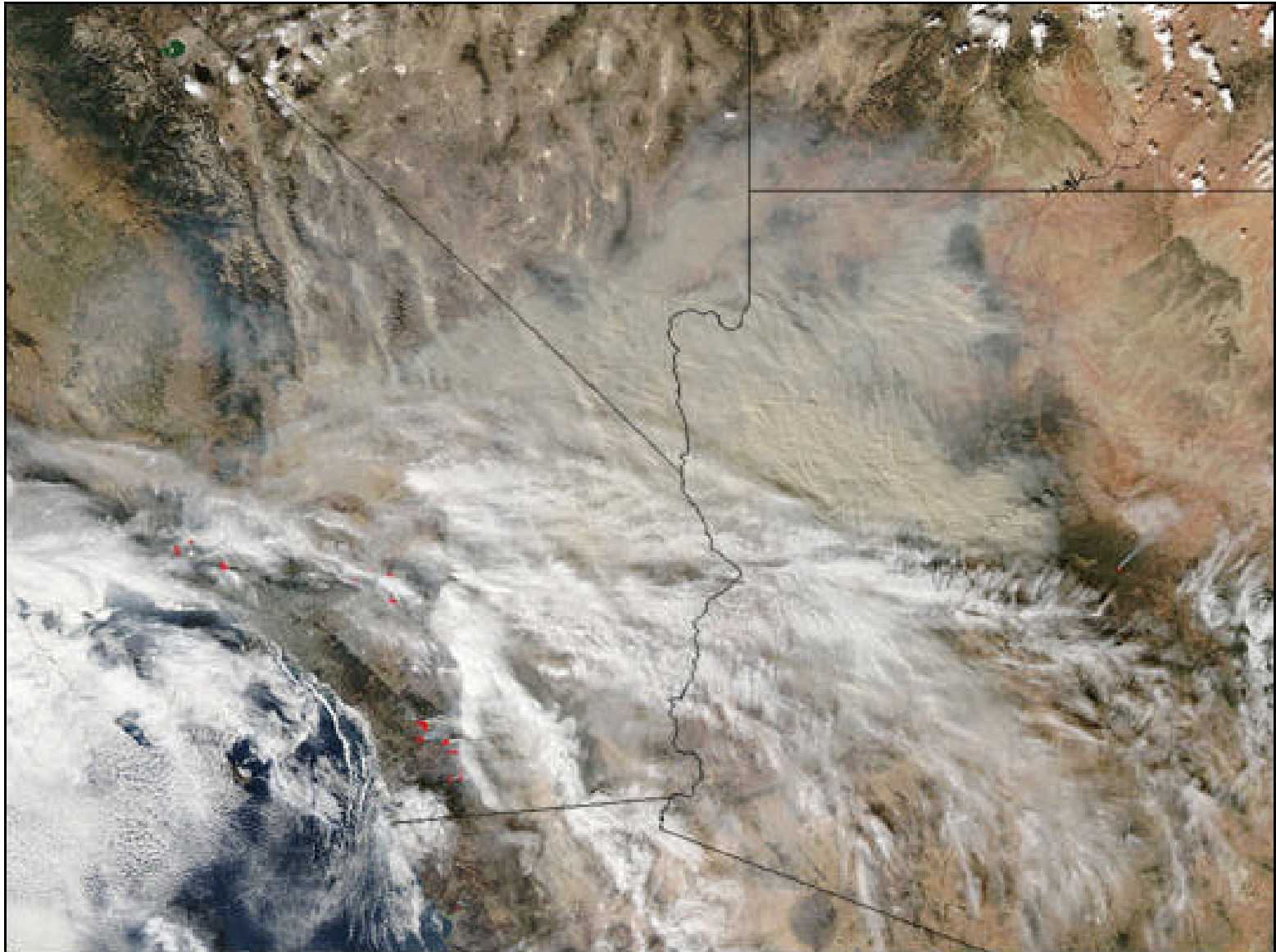
Meteorological Profile:

Low Pressure Trough Signals the End

October 29 - 31

- Fast moving 500 mb trough pushes down the west coast bringing cooler temperatures and drizzle
- Fire fighter get the upper hand
- Onshore flow intensifies generating shifting the smoke impact areas to the northwest of the fires (San Bernardino Mts and Santa Clarita Valley)
- Forecast is improved for the Basin but remains Unhealthy in immediate burn areas

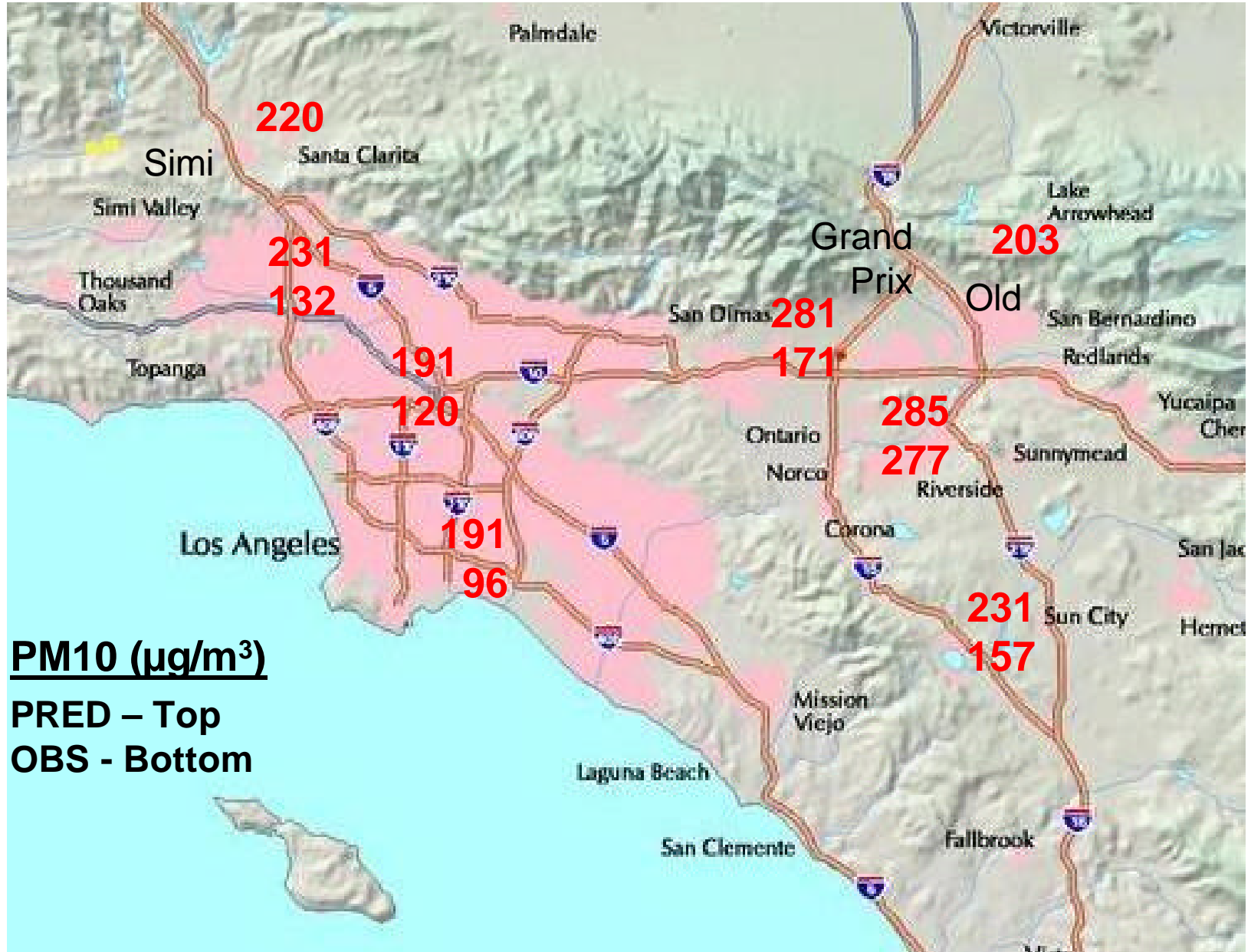
The Wind Shifts: October 29th



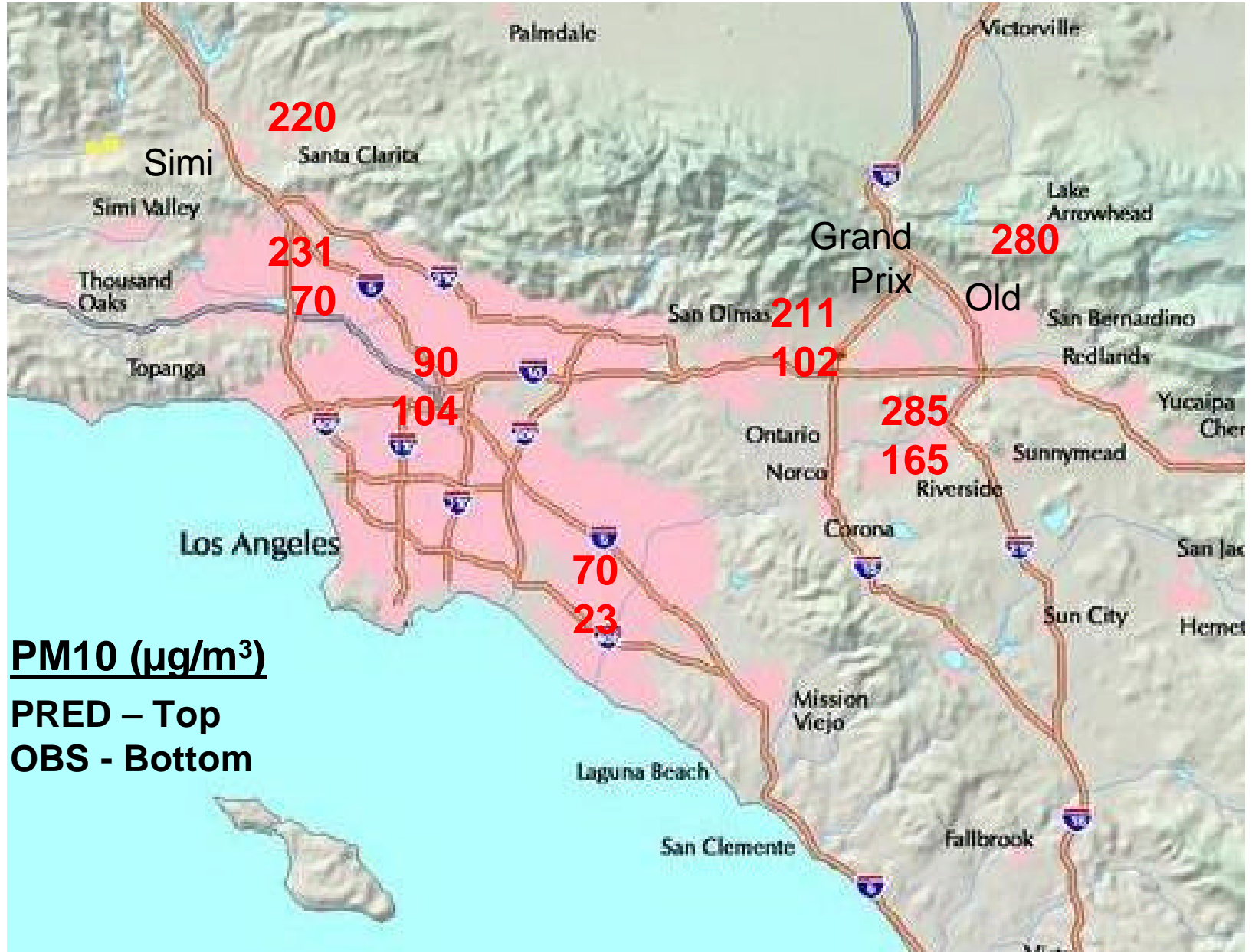
Primary Smoke Impact Area October 29-30



PM10 Predicted and Observed: Oct 29th



PM10 Predicted and Observed: Oct 30th



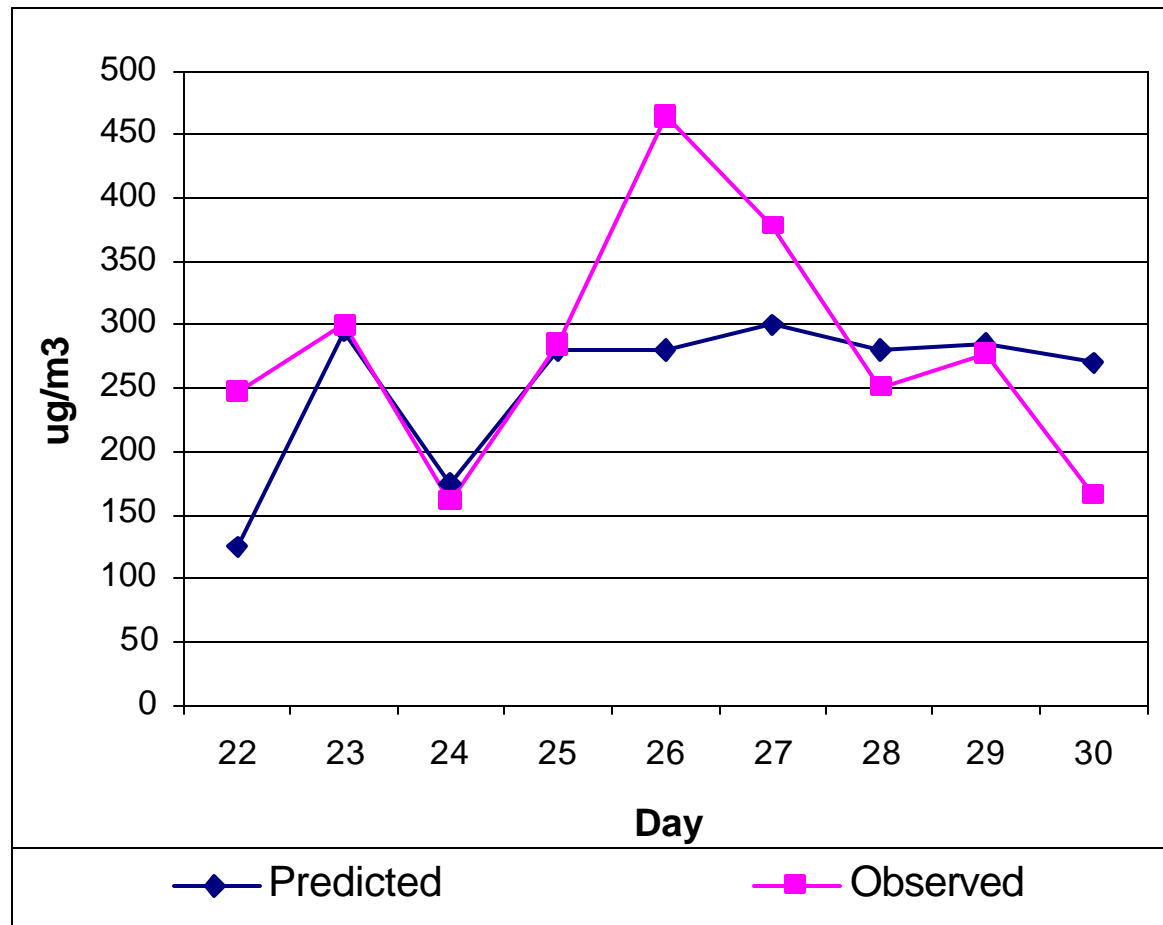
Epilogue

- Hotspot smoke continued for weeks
- Continued isolated predicted high smoke impacts to selected SRA's
- Potential for toxic emissions from burned dwellings (not covered by the forecast)
- Particulates from burn areas became a source of PM for months following fires

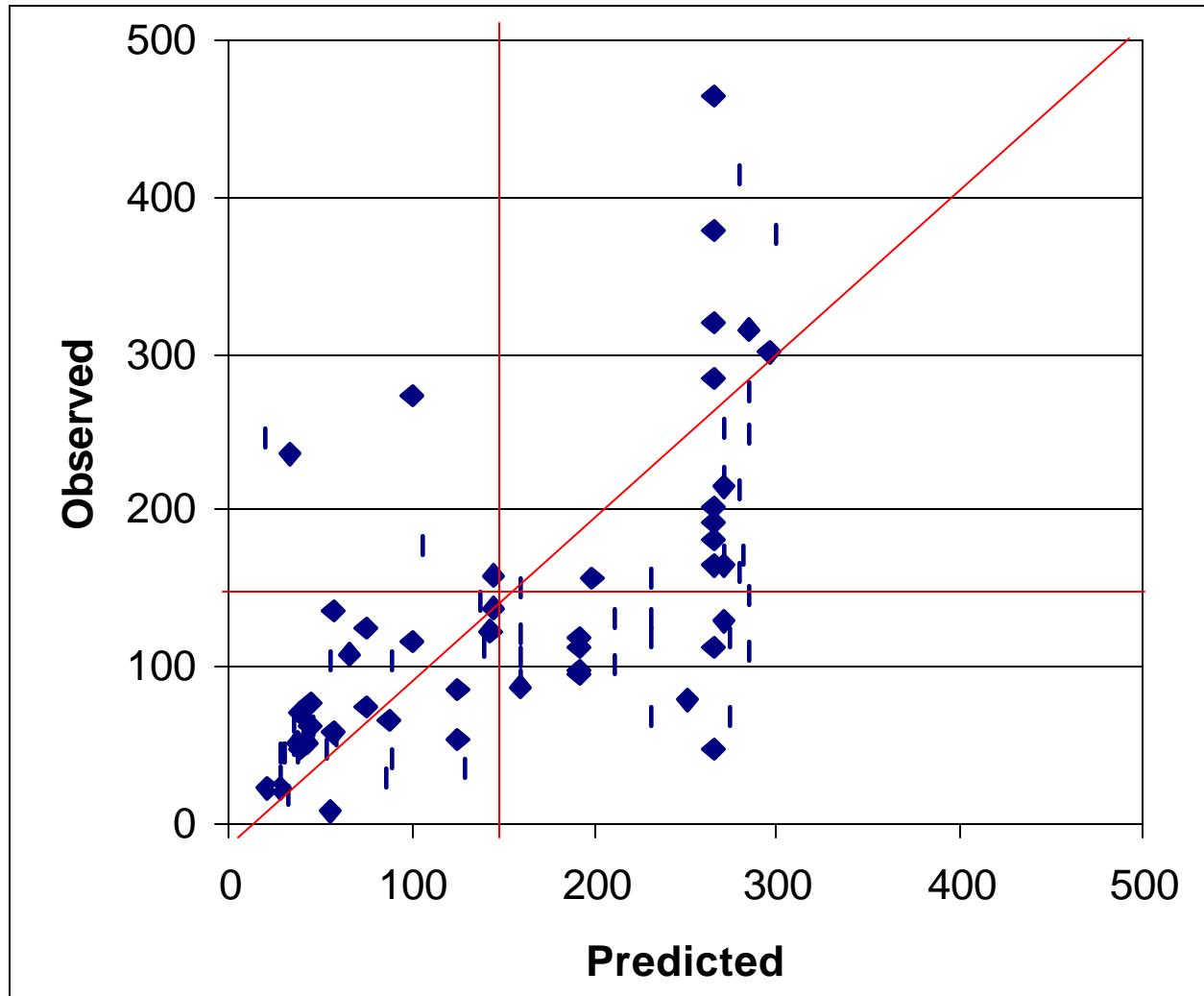
Forecast Summary

- Understood and predicted the weather scenario correctly
- Tended to under predict peak concentrations in the east Basin during the middle of the fire storm
- Lagged the particulate trend in the west Basin at onset of fumigation
- Correctly predicted the shift in the impact areas as the sea breeze returned
- Tendency to over predict final stage of fire for precautionary measures

Daily Maximum Predicted and Observed 24-Hour Average PM10



PM10 24-Hour Avg. Prediction Accuracy: 11-Sites With Continuous Monitoring



PA 76%
for
Federal
Standard

Conclusion

- Daily forecast was effective during the fires
- Forecaster duties were stretched to limits to meet time constraints
- Some forecast error was induced due to the paucity of real-time particulate monitoring
- Need for better characterization of smoke (i.e., percentage falling into coarse and fine modes)
- Need for additional PM monitoring in smoke impacted areas
- Use ASOS airport observations to enhance reporting